ICP/EXT-04-00552
Revision 0

# *Data Quality Assessment Report for the Post-Decontamination Characterization of the Ancillary Equipment Associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 at the Idaho Nuclear Technology and Engineering Center Tank Farm Facility*

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# Data Quality Assessment Report for the Post-Decontamination Characterization of the Ancillary Equipment Associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 at the Idaho Nuclear Technology and Engineering Center Tank Farm Facility

September 2004

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Prepared under Subcontract No. K99-575862/Contract 1329
for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE/NE Idaho Operations Office
Contract DE-AC07-99ID13727

# ABSTRACT

This report documents the data assessment from samples collected during the cleaning of ancillary equipment associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 at the Idaho National Engineering and Environmental Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility. Because Tanks WM-103, WM-104, WM-105, and WM-106 have no concrete vault, ancillary equipment associated with these tanks is limited to the cooling coils. Tank WM-181 is contained in a concrete vault but has no cooling coils. Therefore, ancillary equipment for WM-181 refers only to the vault sump for this tank. The data assessed in this report were generated from the sample analysis of liquids collected following decontamination. Because the samples collected contained less than 15% solids by volume, solids were not analyzed. The data were assessed to determine whether the concentrations of regulated constituents were reduced below the action levels necessary for clean closure. Radionuclide data were compared with an established inventory. The analysis shows all radionuclide activities are less than the inventory values modeled in the performance assessment. The analysis also shows that clean closure action levels were achieved for the chemical constituents in the ancillary equipment. Based on the data analysis, decisions associated with these data can be made with a high degree of confidence.

# FOREWORD

For the tank systems described in this document, ancillary equipment includes the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106, and the vault sump associated with WM-181 at the Idaho National Engineering and Environmental Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility. The sampling and analysis were performed following decontamination as part of the Resource Conservation and Recovery Act (RCRA) clean closure and Department of Energy (DOE) high-level waste tank closure activities underway at the Idaho Nuclear Technology and Engineering Center Tank Farm Facility. The data were compared to three criteria:

- For RCRA clean closure, the data were assessed to determine whether the concentrations of RCRA-regulated constituents were reduced to levels below the action levels specified for clean closure in *Idaho Hazardous Waste Management Act/Resource Conservation and Recovery Act Closure Plan for Idaho Nuclear Technology and Engineering Center Tanks WM-103, WM-104 and WM-105, WM-106, and WM-181* (DOE-ID 2004). This analysis indicates clean closure action levels were not exceeded in ancillary equipment associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181. Because the samples collected contained less than 15% solids by volume, solids were not analyzed.

- For DOE high-level waste tank closure, the radionuclide data were compared with the radionuclide concentrations that were used in the *Performance Assessment for the Tank Farm Facility at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2003). These values were based on sampling data and predicted values from the ORIGEN numerical model. This model is used to predict the radionuclides and relative values in waste streams. An inventory of radionuclides that remain in the tanks after decontamination was prepared for the performance assessment and is used in this document as an indicator of compliance with DOE radionuclide performance objectives.

- The data collected from sampling the post-decontamination, residual liquids from ancillary equipment associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 were assessed against the criteria for data quality specified in the *Sampling and Analysis Plan for the Post-Decontamination Characterization of the WM-103, WM-104, WM-105, WM-106, and WM-181 Tank Residuals* (ICP 2004a).

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# ACRONYMS

| | |
|---|---|
| AL | action level |
| CAS | Chemical Abstract Service |
| CV | coefficient of variation |
| *df* | degree of freedom |
| DOE | Department of Energy |
| DQA | data quality assessment |
| DQO | data quality objective |
| HWMA | Hazardous Waste Management Act |
| ICP-MS | inductively coupled plasma-mass spectrometry |
| IQR | interquartile range |
| LCL | lower confidence limit |
| PA | performance assessment |
| PCBs | polychlorinated biphenyls |
| RCRA | Resource Conservation and Recovery Act |
| SAP | sampling and analysis plan |
| SVOC | semivolatile organic compound |
| TFF | Tank Farm Facility |
| TIC | tentatively identified compound |
| UCL | upper confidence limit |
| USC | United States Code |
| VOC | volatile organic compound |

# Data Quality Assessment Report for the Post-Decontamination Characterization of the Ancillary Equipment Associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 at the Idaho Nuclear Technology and Engineering Center Tank Farm Facility

## 1. INTRODUCTION

This report assesses the quality of data generated from liquid residuals collected following decontamination of the ancillary equipment associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 at the Idaho Nuclear Technology and Engineering Center Tank Farm Facility (TFF). The purpose of this data quality assessment (DQA) report is to:

1. Verify that correct assumptions were made in the development of the data quality objectives (DQOs) about the variance of the sample population

2. Confirm that the number of samples collected was adequate

3. Compare the mean concentration (as represented by the upper confidence limit [UCL]) of Resource Conservation and Recovery Act (RCRA) constituents to approved action levels (ALs) listed in the closure plan (DOE-ID 2004)

4. Compare the mean concentrations of radionuclides to the inventory prepared for the performance assessment (PA) (DOE-ID 2003)

5. Determine if the data distribution is normal or log normal to justify the assumption of normality (normal distribution) in the DQOs.

In general, DQA provides a scientific and statistical evaluation of data to determine if the collected data are of the right type, quality, and quantity to support their intended use. The DQA process is designed around the key idea that data quality, as a concept, is only meaningful when it directly relates to the intended use of the data (EPA 2000a). Two primary questions can be answered using the DQA process:

1. Does the quality of the data permit decisions to be made with the desired degree of confidence?

2. How well can the sampling design be expected to perform over a wide range of possible outcomes? That is, can the sampling design strategy be expected to perform well in a similar study with the same degree of confidence even if the actual measurements are different than those obtained in the present study?

The first question addresses the immediate needs of the study. If the assessment shows that the data are of sufficient quality, then the decision-maker can make decisions using unambiguous data with the desired level of confidence (specified during data collection planning). However, if the data do not provide sufficiently strong evidence to support one decision over another, then appropriate data analysis can alert the decision-maker to the degree of ambiguity in the data. If this is the case, an informed decision can be made about how to proceed. For example, based on the data obtained, more data may be collected or the decision-maker may make a decision knowing there is a greater-than-desirable uncertainty in the decision.

The second question addresses the potential future needs of the study. After the DQA is completed, personnel can determine how well the sampling design may perform at a different location given that different environmental conditions and outcomes may exist. Because environmental conditions vary from location to location, it is important to examine the sampling design over a large range of possible settings to ensure that the design will be adequate in other scenarios.

Evaluation of collected data, referred to as the data life cycle, consists of three steps: planning, implementation, and assessment. The planning phase consists of documenting the data needs and plans for data collection using the DQO process (EPA 2000b). The DQOs define the qualitative and quantitative criteria for specifying the sampling procedure and establish the desired level of confidence for decision-making. The DQOs for this project are documented in the associated sampling and analysis plan (SAP) (ICP 2004a). The implementation phase consists of collecting the necessary data according to the SAP. Data assessment consists of both data validation (to make sure that all sampling and analysis protocols were followed) and the use of the validated data set (to determine if the data quality is satisfactory for making the decisions specified in the SAP).

The steps of the DQA process are:

1. Review the DQOs and sampling design

2. Conduct a preliminary data review

3. Select a statistical test

4. Verify the assumptions of the selected test

5. Draw conclusions from the data.

These steps are discussed in the following sections.

# 2. REVIEW OF THE DATA QUALITY OBJECTIVES AND SAMPLING DESIGN

The DQOs clearly define the principle questions to be addressed and develop the approach that will be taken to resolve the questions. The DQOs consist of developing a problem statement and a decision statement, defining the decision inputs, defining study boundaries, developing a decision rule, establishing decision error limits, and optimizing the design. Data quality objectives were developed for both the tanks and the ancillary equipment simultaneously. The original intent was to pool the samples obtained from all ancillary equipment so that formal statistical tests could be performed on the data. However, the investigation of the data associated with the WM-182 and WM-183 ancillary equipment showed that sump samples come from separate populations and cannot be pooled together for analysis (ICP 2004b). Therefore, statistical analysis is limited to cooling coil data. Because WM-181 does not contain cooling coils, only the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106 are discussed in this DQA .Unlike cooling coils investigated in previous tanks, the cooling coils for these 30,000-gal tanks share a common system. Therefore, statistical analysis could be performed on data from cooling coils associated with Tanks WM-103 through WM-106. The DQOs are summarized below.

1. Problem Statement: Demonstrate that tank decontamination activities have resulted in closure performance objectives being met.

2. Decision Statement: Determine if decontamination of the TFF tank systems has resulted in concentrations of constituents or properties (i.e., pH) of concern in the residuals remaining in the TFF system components being below closure performance standards; if not, further decontamination may be necessary or the Hazardous Waste Management Act (HWMA) (State of Idaho 1983)/RCRA (42 United States Code [USC] 6901 et seq., 1976) landfill standards for closure must be met. Additionally, Department of Energy (DOE) requirements must be met to close the tanks in place.

3. Decision Inputs: Concentrations of hazardous constituents and radionuclides present in ancillary equipment after decontamination.

4. Study Boundaries:

   a. Spatial Boundaries: Residual liquids collected from Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 ancillary equipment following decontamination. The ancillary equipment associated with Tanks WM-103, WM-104, WM-105, and WM-106 includes the cooling coils. The ancillary equipment associated with WM-181 is limited to the vault sump. The data assessed in this report were generated from the sample analysis of liquids that were collected following decontamination of the cited ancillary equipment. Since the samples collected contained less than 15% solids by volume, solids were not analyzed. No data from the sample analysis of residual liquids from the tanks are analyzed in this report. Data assessment of sample analysis of tank residuals will be provided in separate reports (ICP 2004c, 2004d).

   b. Temporal Boundaries: From the onset of decontamination to completion of decontamination. The length of time can vary between different units. Decisions made concerning achievement of closure performance standards will apply for a minimum of 100 years of DOE institutional control.

c. Scale of Decision-Making: The assumptions made in developing the PA (DOE-ID 2003) will specify the scale of decision-making.

d. Practical Constraints: The volume of sample collected from the WM-181 sump is restricted by the limited amount of residuals that can be obtained from this area.

5. Decision Rule: The parameter of interest is the mean concentration of the constituents of concern within the study boundaries. The decision rules are:

a. *If* the true mean concentration of any applicable hazardous waste constituent detected from any piece of equipment is greater than or equal to the maximum concentration of contaminants for the toxicity characteristic listed in 40 *Code of Federal Regulations* 261.24 (2004), or *If* the true mean pH of TFF residuals collected from any individual piece of equipment exhibit the characteristic of corrosivity, *then* either additional decontamination steps will be undertaken or closure to HWMA/RCRA landfill standards will be considered. (It is not known chromium was used in the cooling coils as a corrosion inhibitor, but it is known that the contents of the cooling coils never came in contact with the tank waste. Therefore, only chromium is the only metal of interest in the cooling coil rinsates and only chromium and pH data from the analyses of the cooling coil rinsates were used in assessing whether or not TFF cooling coil residuals meet the HWMA/RCRA clean-closure ALs).

b. *If* the true mean concentration of any hazardous constituent detected in total constituent analyses of the TFF residuals collected from statistically similar populations (i.e., sample locations) is greater than the AL specified in the closure plan, *then* additional decontamination steps may be undertaken. Closure to HWMA/RCRA landfill standards will be considered at final closure of the TFF.

c. *If* the concentrations of hazardous constituents indicate that the closure performance standards have been met, *then* the TFF will be closed under a HWMA/RCRA clean closure.

6. Decision Error Limits: The outputs for the decision error limits are the null and alternative hypotheses and a quantification of the allowable error rates. The null hypothesis is “The concentration of at least one hazardous or radioactive constituent in TFF residuals following decontamination is equal to or exceeds ALs.” Conversely, the alternative hypothesis is “The concentrations of all hazardous or radioactive constituents in TFF residuals following decontamination are less than the specified ALs.” The lower boundary of the gray region ($\Delta$) is set at 80% of the AL for all constituents of concern. Using the stated null hypothesis, the upper boundary of the gray region is always the constituent-specific AL. For pH, the gray region is bounded on one side by 2.0 and 12.5 (the ALs) and on the other side by 2.1 and 12.4, respectively. In the case of acidic conditions (low pH), the “lower boundary” of the gray region is actually a pH value greater than the action limit because the “lower boundary” of the gray region is always in a direction away from the action limit that would result in rejection of the null hypothesis if the true mean value was equal to that value. That is, the gray region is that range of values where controlling false-negative decision error is deemed unimportant relative to the cost of controlling that error. The chance of a false-positive decision error ($\alpha$) and the chance of a false-negative decision error ($\beta$) will both be set at 5%. Because the number of samples obtained from the WM-181 sump is too small to perform a statistical test, formal statistical hypothesis testing can be done only on the cooling coil data. Therefore, the above outputs apply only to the cooling coils since such a definition would be inappropriate for the other equipment covered in this report.

7. Design Optimization: A simple random sampling method was used to obtain samples. The standard deviation (σ) was estimated to be 10% of the AL. The validity of this assumption is assessed later in this DQA report. Given the chosen α, β, and Δ in conjunction with the estimated value for σ, a sample size (*n*) of 5 was selected using Equation (1):

$$n = \frac{\left(z_{1-\alpha} + z_{1-\beta}\right)^2 \sigma^2}{\Delta^2} + \frac{1}{2} z_{1-\alpha}^2 \qquad (1)$$

where

| | | |
|---|---|---|
| $n$ | = | the appropriate number of samples to collect to satisfy the DQOs |
| $z_x$ | = | the $z$ value for the x[th] quantile of the standard normal distribution (from statistical tables) |
| α | = | false-positive rate (5% or 0.05) |
| β | = | false-negative rate (5% or 0.05) |
| σ | = | estimated standard deviation of the population |
| Δ | = | minimum detectable difference (the difference between the AL and the value at which the decision-maker wants to specify a false-negative decision error rate; in this case, Δ is 20% of the constituent-specific AL). |

Equation (2) shows the solution of this formula for the WM-103, WM-104, WM-105, and WM-106 cooling coils sampling and analysis activity:

$$n = \frac{\left(1.645 + 1.645\right)^2 (10)^2}{(20)^2} + \frac{1}{2}(1.645)^2 = 4.06 \qquad (2)$$

Based on the results of Equation (2), five samples of liquids from the cooling coils following decontamination were collected for the applicable analyses. However, sampling for the vault sump associated with WM-181 was controlled by practical constraints. One sample of vault sump rinsate was collected.

# 3. PRELIMINARY DATA REVIEW

The purpose of the preliminary data review is to examine the data using graphical methods and numerical summaries to gain familiarity with the data and achieve an understanding of the "structure" of the data. A preliminary data review should be performed whenever data are used, regardless of the purpose of the data. This type of examination allows the limitations of the data to be identified and the proper approach for data analysis to be determined. It is important to note that the WM-103, WM-104, WM-105, and WM-106 cooling coil data are the only data of sufficient quantity to conduct a preliminary data review, while the data from the WM-181 vault sump are examined in tabular format.

The two main approaches to a preliminary data review are: (1) calculation of basic statistical quantities (or summary statistics) and (2) graphical representations of the data. Appendix A of this report provides the graphical representations of cooling coil data from Tanks WM-103, WM-104, WM-105, and WM-106. Tank WM-181 does not have cooling coils. The calculated summary statistics will be discussed in this section, and the graphical review of the data will be discussed in Section 8 when the distribution of the cooling coil data is assessed.

The summary statistics calculated for the detected constituents from the cooling coils provide information regarding the measures of center (mean and median) and measures of spread (standard deviation, coefficient of variation [CV], interquartile range [IQR], and range). One measure of primary interest is the center of the data. The average ( $\bar{x}$ ), or the mean, is the most commonly used measure of the central tendency of the data. However, it can be heavily influenced by outliers and by asymmetric data. The mean is calculated using Equation (3):

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \tag{3}$$

where

$\bar{x}$ = mean

$n$ = number of observations

$x_i$ = $i^{th}$ observation.

The median is the preferred measure of the center of the data if outliers are present in the data or if the data are skewed. The median is the observation such that 50% of the data lie below the median and 50% of the data lie above the median. If the data are perfectly symmetric, the mean and the median will be equal to each other.

Another quantity of interest is the spread of the data. The standard deviation ($s$) is the most commonly used measure of spread. One reason for this is that it is fairly easy to interpret and is a key measure that is used in many other statistical methods. Because it is calculated using the average, it is also sensitive to outliers and to data that are not symmetric. The standard deviation is calculated using Equation (4):

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \tag{4}$$

where

$s$ = standard deviation

$n$ = number of observations

$x_i$ = $i^{th}$ observation

$\bar{x}$ = mean of the observations.

The CV was also calculated for each detected analyte for which a sufficient number of samples for computation existed. The CV is a relative measure of variation. That is, it is a measure of the standard deviation relative to the mean, expressed as a percentage. This measure provides a way to more directly compare the standard deviations of two different data sets that may otherwise not be directly comparable. However, it is important to note that the mean of the data may be very close to zero or very far away from zero and the spread may be independent from the distance of the mean from zero. Therefore, no firm guidelines have been established for interpreting the CV. The formula for calculating the CV is:

$$CV = \frac{s}{\bar{x}} \times 100\% \tag{5}$$

where

$s$ = standard deviation

$\bar{x}$ = mean of the observations.

The IQR is a measure of spread that is not influenced by outliers. It is calculated by subtracting the first quartile from the third quartile. The first quartile is the 25$^{th}$ percentile of the data and the third quartile is the 75$^{th}$ percentile of the data. The IQR is a preferred measure of spread when extreme outliers or noted asymmetry exist in the data. Otherwise, the standard deviation is the preferred measure of spread.

The range, another measure of spread in the data, is calculated by subtracting the smallest value in the data from the largest value. It can be a valuable piece of information in characterizing the spread of the data but can be deceptively large if the data contain any outliers. Therefore, the data should always be examined for outliers when the range is used as a summary statistic.

The five-number summary was calculated for pH and chromium in the rinsates collected from the WM-103, WM-104, WM-105, and WM-106 cooling coils. No gamma-emitting radionuclides were detected in the rinsates collected from the WM-103, WM-104, WM-105, and WM-106 cooling coils; therefore, a five number summary was not performed for the gamma-emitting radionuclide data from the cooling coils. The five-number summary is a presentation of the minimum value, the first quartile, the median, the third quartile, and the maximum value of the data. This summary provides non-parametric information about the general spread and pattern of the data.

It is difficult to read a table of numerical summary statistics and identify the degree of symmetry or normality of the data. Graphical representations of the data include boxplots and normal-quantile plots. Boxplots are a way of graphically viewing the five-number summary. The plot consists of a central box with a line or other mark inside of the box. Two lines come out of the ends of the box in either direction. The line, or mark, inside the box represents the median, the edges of the box represent the two quartiles, and the extreme ends of the lines represent the largest and smallest observations within 1.5*IQR from the box, which represent the minimum and maximum values when the data set contains only five observations.

This type of plot allows for a quick and comprehensive analysis of the symmetry of the data. It can be easily determined if the data are symmetric, right-skewed, or left-skewed. Right-skewed data have a lengthened tail on the higher values of the distribution. This tail pulls the mean toward it, causing the mean to be high relative to the center of the data. This makes it more likely to declare that further decontamination is needed when, in fact, decontamination efforts have been sufficient. Left-skewed data have a lengthened tail on the lower values of the distribution. This tail pulls the mean toward it causing the mean to be lower than the center of the data. Left-skewed data will cause the UCL to be low-biased making it more likely to show the decontamination efforts have been successful for that analyte when, in fact, the concentration of that analyte exceeds the AL.

The normal-quantile plot is a plot that is used to determine if the data follow a normal distribution. If the data follow a normal distribution then the points on the graph will lie along a straight line. Any deviations from a straight line are indicative of deviations from normality. If the data veer away from the line at one end of the line or form a “U” shape, then the data are asymmetric. If the data veer away from the line at both ends in an “S” shape, then the tails of the distribution are either too heavy or too light to assume a normal distribution. A point that is far away from the other data at either end of the plot indicates there might be an outlier in the data. It is important to note that no real world data set is perfectly normal so a certain amount of deviation from the line is to be expected, even in data that are sufficiently normal for parametric statistical analysis.

A formal preliminary data analysis, as outlined above, was not performed on the data from the vault sump because too few data points are available to perform the necessary calculations or to construct meaningful graphs. A formal preliminary data analysis was conducted for the WM-103, WM-104, WM-105, and WM-106 cooling coil data, and the graphical representations are shown in Appendix A to aid the data user in assessing the symmetry and normality of the data collected.

Each type of analyte (i.e., metals, anions, organic constituents, pH, and radionuclides) is discussed separately in Sections 7 and 8, as applicable. The impact of laboratory performance on the data quality is discussed, and detected analytes are examined statistically.

# 4. STATISTICAL TEST SELECTION

Once the preliminary data review has been completed, an appropriate statistical hypothesis test may be selected to answer the question(s) for which the data were collected. Because each statistical hypothesis test requires the data to be of sufficient quality and quantity, the data are analyzed to determine whether the assumptions of the desired test(s) are met.

One of the primary requirements of many hypothesis tests is that the distribution of the sample mean is normal. Tests that require the assumption of normality are generally more efficient than non-parametric tests (i.e., tests that do not require the data to follow a specific distribution). That is, a test that requires the sample mean to have a normal distribution can provide more accurate and reliable answers with fewer data points than a test that does not require the data to conform to a specific distribution. If the data have a normal distribution, then the sample mean will also have a normal distribution. Data not demonstrating a normal distribution can be transformed and used if the transformed data are normally distributed. However, if the data do not have a normal distribution and cannot be transformed to achieve normality, the sample mean may still have a normal distribution. The Central-Limit Theorem states that the distribution of the sample mean will be normal, regardless of the distribution of the data, if the sample size is sufficiently large. The more the data deviate from the normal distribution, the larger the sample size must be to ensure that the distribution of the sample mean is normal. Bootstrapping is a simulation technique that can be used to assess the distribution of the sample mean. If data are not normal in distribution and normality cannot be achieved through transformation, bootstrapping will be used to assess the distribution of the sample mean.

Non-parametric tests are most appropriate if the sample mean does not follow a normal distribution and an appropriate transformation cannot be found. Although they do not require the data to exhibit a normal distribution, most non-parametric hypothesis tests also have assumptions that must be met. One of the most common assumptions for a one-sample non-parametric test is that the data have a symmetric distribution. The assumptions of a selected hypothesis test, whether parametric or non-parametric, must be verified before the test is performed on the data.

The primary questions to be answered in relation to the post-decontamination contents of ancillary equipment for Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 are:

- Does the mean concentration of any constituent of concern exceed the specified AL or radionuclide inventory?
- Do the data support the assumptions of variance (standard deviation squared) and normal distribution?

The appropriate test to answer the first question compares the sample mean to a constituent-specific AL. Three primary tests are appropriate for answering this type of question: the one-sample $z$-test, Student's one-sample $t$-test, and the Wilcoxin signed rank test.

The $z$-test requires: (a) knowledge of the population standard deviation ($\sigma$), and (b) that the sample mean follows a normal distribution. Because the population standard deviation for each constituent concentration in the post-decontamination contents is not known, the $z$-test will not be considered further. The $t$-test allows the use of the sample standard deviation ($s$), which is an estimate of $\sigma$. The $t$-test also requires that the sample mean follows an approximate normal distribution. It is important to note that if the data follow a normal distribution, the sample mean will also have a normal distribution. However, if the data do not follow a normal distribution, the sample mean will still follow a normal distribution if the sample size is sufficiently large (as shown by the Central-Limit Theorem). The Wilcoxin signed rank test is a non-parametric test that compares a sample mean to an AL but does not require the data to follow a normal distribution. The primary assumption for this test is that the data are symmetric. If the data are analyzed and found to be neither normally distributed nor symmetric, the data may be transformed. Data are transformed by performing the same operation on each data point (such as taking the natural logarithm of each observation). If the transformed data have a normal distribution or are symmetric, then the appropriate test can be performed on the transformed data. If the UCL of an analyte for which the data have been transformed is desired, it can be calculated using the transformed data. The AL can then be transformed using the same function and directly compared to the UCL within the transformed space. If an appropriate transformation cannot be found to achieve normality in the data, bootstrapping will be done to determine if the sample mean follows a normal distribution despite the non-normality of the data.

Because the *t*-test allows use of the sample standard deviation (*s*) and is a very powerful test for small data sets, the *t*-test was chosen as the most desirable means for testing the null hypothesis. After selecting a statistical test, it is necessary to verify the assumptions of the test selected. These assumptions are examined in Section 5.

# 5. VERIFICATION OF THE ASSUMPTIONS FOR THE SELECTED HYPOTHESIS TEST

This section examines the underlying assumptions of the statistical hypothesis test in light of the data collected. Both parametric and non-parametric tests require that the samples are independent of each other and this assumption should be verified if the sampling points were not able to be randomly selected. In addition, to select the appropriate test, the distributions of the data obtained for each analyte need to be evaluated. Parametric tests, which require the data to be normally distributed, can provide more accurate and reliable answers with fewer data points than non-parametric tests, and therefore, are the preferred tests. Consequently, it must first be determined if the data follow a normal distribution or if they can be transformed to follow a normal distribution. This is done using graphical methods such as histograms and normal-quantile plots. Statistical tests, such as the Shapiro-Wilk test or the $\chi^2$ test for distributions can be used to determine if the data follow a normal distribution, but each has limitations. If the data set is large, even data that are very close to normal in distribution may not pass the test. With a small number of data points, it is difficult for distributional tests to detect deviations from normality in the data.

In the analysis of the rinsate data from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106, graphical methods and the Shapiro-Wilk test were used to assess normality, where appropriate. Boxplots and normal-quantile plots were prepared using S-Plus 2000 (Insightful Corporation 2000). Analyse-It software (Analyse-It 2003) was used to perform the Shapiro-Wilk test calculations. Because no more than five samples were taken from any system, histograms were not very informative. Normal-quantile plots were the primary graphical method used to evaluate whether the data exhibit a normal distribution. These plots are presented in Appendix A of this report. The assessment of normality of the data is discussed in Section 7.

Since the primary objective of this DQA analysis is to determine if the mean concentration of a specified analyte is less than its associated AL, the following criteria have been developed in dealing with deviations from normality:

- If the Shapiro-Wilk test indicates that the data are normally distributed at the $\alpha = 0.05$ level and the summary statistics and plots indicate that the data are symmetric, then the *t*-test will be performed on the raw data.

- If the Shapiro-Wilk test conclusively shows that the data are normally distributed (the *p*-value is comfortably greater than 0.05), but the boxplot and other summary statistics indicate that the data might be right-skewed, then the raw data will be used for the *t*-test. However, if the data in this situation fail the Shapiro-Wilk test, a transformation that can make the data closer to normal in distribution will be sought and the test will be repeated.

- If the *p*-value for the Shapiro-Wilk test is close to or less than 0.05 and the data are left-skewed, then a transformation will be sought to bring the distribution into the acceptable range of normality.

- If the data are right-skewed and the *p*-value for the Shapiro-Wilk test is less than or close to 0.05, indicating that the data are likely non-normal, then an appropriate transformation will be sought for the data.

- If an appropriate transformation cannot be found then bootstrapping will be used to compute a non-parametric 95% UCL of the data for comparison against the AL. This will also be done if the data are left-skewed and a suitable transformation cannot be found.

The results of the Shapiro-Wilk test are reported for all of the reported results as well as for any successful transformations. Results for unsuccessful transformations are not reported because many transformations may have been attempted for each analyte that exhibited non-normality. It is also important to note that the Wilcoxin signed rank test was not considered for data that exhibited non-normality because these data were also asymmetric. It is possible to determine how the type of asymmetry will affect a *t*-test, but it is not as clear how asymmetry will affect the results of the Wilcoxin signed rank test.

One of the primary assumptions for performing the *t*-test is that the samples are independent from the location from which they were collected. In the WM-181 vault, one rinsate sample was collected from the sump. It was shown in the WM-182 and WM-183 DQA (ICP 2004b) that sample results taken from the sumps and valve boxes were dependent on the location from which they were collected. Therefore, it would not be appropriate to pool the data from the WM-181 sump with the cooling coils for analysis. It is not necessary, or appropriate, to repeat the analysis on the WM-181 data since the dependence has already been proven. Therefore, it will not be repeated in this document.

# 6. IMPLEMENTATION OF THE STATISTICAL TEST

If the preliminary data analysis and the evaluation of test assumptions indicate that the *t*-test may be appropriately applied to determine if the mean concentration of any constituent of concern exceeds its specified AL, then the test will be applied to the data. It is important to note that distributional assumptions will only be addressed for the cooling coil data since none of the other equipment has data of sufficient quantity to assess distribution.

The one-sample *t*-test is the statistical hypothesis test that was selected for use on the observed data (provided the assumptions of the test are met). This test compares the sample mean with the AL to determine the likelihood that the population mean exceeds the AL. This test can be implemented in several ways. The traditional method is to compute a *t*-statistic from the observed data and the AL and then use it to determine the appropriate *p*-value. The *p*-value is the probability that a sample mean as small, or smaller, than the one observed is seen if further decontamination is necessary. Therefore, the smaller the *p*-value is, the less likely it is that the contamination in the ancillary equipment exceeds the AL. Another way to run the *t*-test is to compare the UCL to the AL. If the UCL is less than the AL then it can be concluded that sufficient decontamination activities have been performed. The UCL comparison is the method that was used in this document.

The UCL of the sample mean is calculated using Equation (6):

$$UCL = \bar{x} + t^*_{1-\alpha,df} \frac{s}{\sqrt{n}} \tag{6}$$

where

| | | |
|---|---|---|
| $\bar{x}$ | = | sample mean. |
| $t^*_{1-\alpha,df}$ | = | *t*-statistic for the confidence level, $(1 - \alpha)*100\%$, and degree of freedom, *df*. In this case, the confidence is $(1 - 0.05)*100\% = 95\%$ and the *df*s are $n - 1 = 4$. From statistical tables, this corresponds to a value of 2.132 (or 2.776 for pH as explained below). |
| $s$ | = | sample standard deviation. |
| $n$ | = | number of samples taken. |

The lower confidence limit (LCL) is also of importance to analyzing the pH. Because the pH has ALs for both high pH and low pH, it is necessary to determine if the pH is less than the LCL. Because both the LCL and the UCL are important, the *t*-value for the LCL and UCL will be determined with $\alpha/2$ instead of $\alpha$ to ensure that the total probability of a false-positive decision error occurring is $\alpha$ rather than $2*\alpha$. The LCL is compared to a pH of 2 to ensure that the true mean is greater than 2 at the specified degree of confidence. The LCL is calculated using Equation (7):

$$LCL = \bar{x} - t^*_{1-\alpha/2,df} \frac{s}{\sqrt{n}} \tag{7}$$

where

$\bar{x}$ = sample mean.

$t^*_{1-\alpha/2,df}$ = $t$-statistic for degree of confidence, (1 – α/2)*100%, and degree of freedom, *df*. In this case, the confidence is (1 – 0.025)*100% = 95% and the *df*s are $n - 1 = 4$. Because the LCL and the UCL are being compared to an AL, α/2 = 0.025 is used to determine the appropriate *t*-value. From statistical tables, this corresponds to a value of 2.776.

$s$ = sample standard deviation.

$n$ = number of samples taken.

The UCL is used to estimate the largest likely value of the population mean based on the observed data. The ALs and decisions about whether or not the ALs may have been exceeded for each of the detected constituents will be presented in the following sections. The LCL is also presented for pH to ensure that the rinsate is neither too acidic nor too basic.

If the data are not normal in distribution then bootstrapping will be used to compute a 95% UCL for the data. Bootstrapping is a technique in the family of Monte Carlo methods that resamples the observed data to obtain more information about the population. In the case of the rinsate data, the observed data for the analyte in question will be sampled, with replacement, five times. A sample mean will then be computed from this "new" data set. This process will be repeated 1,000 times to obtain 1,000 sample means. The 95% UCL of the data is the 95th percentile of the 1,000 sample means generated by the bootstrap method. This UCL can be directly compared to the action or inventory level to perform the appropriate statistical test (for further details on bootstrapping see *An Introduction to the Bootstrap* [Efron and Tibshirani 1994]).

No specific regulatory thresholds relative to the activity (i.e., concentrations) exist for the radionuclides left in any one tank after decontamination. Rather, the total inventory of radionuclides remaining in all closed components of the TFF will be evaluated following completion of the TFF decontamination efforts. The PA (DOE ID 2003) conducted to address the DOE Order 435.1 (2001) closure requirements provides an estimate of acceptable radionuclide concentrations in the liquids remaining in each tank following decontamination. While these modeled levels are not the basis for a decision such as continuing to clean a tank, the modeled values required to meet DOE closure standards can be compared with the levels achieved through decontamination efforts. Because of this, hypothesis testing is not required to make decisions concerning whether decontamination may cease; however, hypothesis testing using the modeled value as the AL provides information on the decontamination effort for the radionuclides.Because one rinsate sample was collected from the WM-181 sump, the reported concentrations of radionuclides are compared directly with the PA modeled inventory (DOE-ID 2003) in Subsection 8.5.

# 7. SUMMARY OF DATA ANALYSIS FOR WM-103, WM-104, WM-105 AND WM-106 COOLING COILS

The WM-103, WM-104, WM-105, and WM-106 cooling coils rinsates were collected and analyzed for chromium, pH, and gamma-emitting radionuclides. All results reported for the gamma-emitting radionuclides were identified as undetected and assigned the validation flag "U" (Portage Environmental, Inc. 2004a). Therefore, no further discussion of radionuclide data is necessary in this section. Metals and pH data are examined in the following subsections.

## 7.1 Analysis of Metals in the Cooling Coils Rinsate

### 7.1.1 Preliminary Data Analysis for the Metals

The preliminary data analysis consists of several statistical quantities of interest and the five-number summary for the metals. The measures of central tendency and spread for chromium are listed in Table 1. Table 2 provides the five-number summary for chromium. Boxplots and normal-quantile plots for chromium are shown in Appendix A. The chromium results were validated according to technical guidelines. According to the guidelines, validation flags are assigned depending on the laboratory performance on quality control analyses. No quality control issues were identified (Portage Environmental, Inc. 2004b). Laboratory results and associated validation flags for WM-103, WM-104, WM-105, and WM-106 cooling coil data are presented in Appendix B.

Results of the preliminary data analysis indicate that the chromium data are potentially right-skewed. This asymmetry will be further addressed in the following subsection.

Table 1. Measures of central tendency and spread for metals in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Mean (µg/L) | Median (µg/L) | Standard Deviation (µg/L) | Coefficient of Variation (%) | Interquartile Range (µg/L) | Range (µg/L) |
|---|---|---|---|---|---|---|
| Chromium | 81.3 | 68.7 | 46.2 | 56.8 | 16.5 | 114 |

Table 2. Five-number summary for metals in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Minimum Value (µg/L) | First Quartile (µg/L) | Median (µg/L) | Third Quartile (µg/L) | Maximum Value (µg/L) |
|---|---|---|---|---|---|
| Chromium | 48.0 | 55.6 | 68.7 | 72.1 | 162 |

### 7.1.2 Verification of Statistical Test Assumptions for the Metals Data

Two of the primary assumptions made for performing the one-sample *t*-test with the desired degree of confidence are that the sample mean follows a normal distribution and that the standard deviation is less than 10% of the AL. Chromium data were analyzed using normal-quantile plots and the Shapiro-Wilk test to assess the normality of the data. Table 3 contains the results of the Shapiro-Wilk test for the chromium. The plots and the Shapiro-Wilk W test show that the data are not sufficiently normal in distribution to perform a *t*-test on the chromium data. However, a suitable transformation was found for chromium. Thus, a *t*-test was performed on the transformed chromium data. The assumption that the standard deviation was less than 10% of the AL was made in order to determine the appropriate sample size. The results listed in Table 4 show that this assumption was met.

Table 3. Results of the Shapiro-Wilk test for metals in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Test Statistic | *p*-value | Are Data Normal? |
|---|---|---|---|
| Chromium | 0.7460 | 0.0273 | No |
| Chromium (ln[x] transformation) | 0.8538 | 0.2067 | Yes |

Table 4. Verification of the standard deviation assumption for metals in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Standard Deviation (µg/L) | Action Level (µg/L) | Percentage |
|---|---|---|---|
| Chromium | 46.2 | 900 | 5.13% |

***7.1.2.1 Implementation of the Statistical Test for the Metals Data.*** Results from the previous subsections indicate that the *t*-test is an appropriate method for analyzing the chromium data as long as the natural logarithm transformation is used. Results listed in Table 5 show that the chromium levels are below the AL. Therefore, it can be seen that closure performance criteria have been met for all metals of concern in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

Table 5. Summary of post-decontamination concentrations of metal constituents in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Mean | UCL | Units | *t*-value | Action Level | Action Level Exceeded? |
|---|---|---|---|---|---|---|
| Chromium (ln[x] transformation) | 4.30 | 4.75 | ug/L | 2.132 | 6.80[a] | No |

a. The action level for chromium (900µg/L) is shown following the ln[x] transformation.

## 7.2 Analysis of pH in the Rinsate from Tanks WM-103, WM-104, WM-105, and WM-106 Cooling Coils

### 7.2.1 Preliminary Data Analysis for pH

The preliminary data analysis consists of several statistical quantities of interest and the five-number summary for pH. Measures of central tendency and spread for pH are listed in Table 6. Table 7 provides the five-number summary for pH. The boxplot and normal-quantile plot for pH can be found in Appendix A. Plots show that the data appeared to be right-skewed. The distribution of pH will be discussed further in the following subsection. Results for pH analyses were validated according to technical procedures, and validation flags denote the laboratory performance on quality control analytes. No discrepancies in the pH analyses were noted during validation (Portage Environmental, Inc. 2004c).

Laboratory results and associated validation flags for pH data for WM-103, WM-104, WM-105, and WM-106 cooling coils are listed in Appendix B.

Table 6. Measures of central tendency and spread for the pH of the rinsate from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Mean | Median | Standard Deviation | Coefficient of Variation (%) | Interquartile Range | Range |
|---|---|---|---|---|---|---|
| pH | 7.6 | 7.3 | 0.70 | 9.2 | 0.30 | 1.7 |

Table 7. Five-number summary for the pH of the rinsate from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Minimum Value | First Quartile | Median | Third Quartile | Maximum Value |
|---|---|---|---|---|---|
| pH | 7.1 | 7.2 | 7.3 | 7.5 | 8.8 |

#### *7.2.1.1 Verification of Statistical Test Assumptions for the pH Data.*

Two of the primary assumptions in performing the *t*-test on the pH data with 95% confidence are that the sample mean follows a normal distribution and that the standard deviation is no more than 10% of the AL. Results of the Shapiro-Wilk test show that the data are not sufficiently normal in distribution to perform the *t*-test. A transformation was sought for the data but a sufficiently effective transformation was not found. Bootstrapping was performed to estimate the distribution of the sample mean. Results showed that the distribution of the sample mean was right-skewed, and therefore, not normal in distribution. Consequently, the LCL and UCL will be computed using the bootstrap method. Table 8 contains the results of the Shapiro-Wilk test for pH.

Table 9 contains the results of the standard deviation assumption. However, it is important to note that because a neutral pH is expressed by a value of 7.0 rather than 0, the absolute value of the difference between the AL and 7.0 was used for comparison. Therefore, the AL used to assess the standard deviation assumption is the difference between 7.0 and the AL. Because the pH data are basic, 5.5 was used to compare against the standard deviation. If the pH data were acidic, the standard deviation would be compared to 5.0. The ratio of the standard deviation to the AL was 12.7%, which is in excess of the estimated 10%. Therefore, the standard deviation assumption has not been met. However, since a 95% UCL is used to implement the statistical test, $\alpha$ is not affected by the fact that the standard deviation is more than 10% of the AL. The chance of committing a false positive error ($\beta$) increased to 0.09. Observed measurements of pH are very close to neutral so this increased $\beta$ did not affect the ability to show that pH levels were confidently within the acceptable interval specified in the closure plan.

Table 8. Results of the Shapiro-Wilk test for the pH of the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Test Statistic | *p*-value | Are Data Normal? |
|---|---|---|---|
| pH | 0.7420 | 0.0251 | No |

Table 9. Verification of the standard deviation assumption for the pH of the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Analyte | Standard Deviation | Action Level | Percentage |
|---|---|---|---|
| pH | 0.70 | 5.5 | 12.7% |

***7.2.1.2 Implementation of the Statistical Test for the pH Data.*** Results from the previous subsections indicate that it is inappropriate to perform the *t*-test on the pH data. Thus, the LCL and UCL were computed using the bootstrap method. It can be seen from the results listed in Table 10 that the pH level is not near either of the ALs. Therefore, it can be concluded that closure performance criteria has been met for the pH of the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

Table 10. Summary of post-decontamination measurements of the pH in the rinsates from the cooling coils associated with Tanks WM-103, WM-104, WM-105, and WM-106.

| Constituent | Mean Concentration | 95% LCL | 95% UCL | Lower Action Level | Upper Action Level | Action Level Exceeded? |
|---|---|---|---|---|---|---|
| pH | 7.6 | 7.18[a] | 8.22[a] | 2.0 | 12.5 | No |

a. LCL and UCL were computed using the bootstrap method.

### 7.2.2 Conclusions

Five samples of the final decontamination rinsate were taken from the Tanks WM-103, WM-104, WM-105, and WM-106 cooling coils. Samples were analyzed for constituents and properties (i.e., pH) of concern as well as gamma-emitting radionuclides. The pH was within the regulatory bounds specified in the closure plan. Chromium was the only constituent that was detected. All measurements were well below the AL. Therefore, it can be concluded that the closure performance criteria has been met with respect to the cooling coils for Tanks WM-103, WM-104, WM-105, and WM-106.

# 8. SUMMARY OF DATA ANALYSIS FOR THE WM-181 VAULT SUMP

This section provides the statistical analysis that was performed on the data associated with the WM-181 vault sump. One sample was collected from the vault sump.

Based on the investigation of the data associated with the WM-182 and WM-183 vault sumps (ICP 2004b), these samples come from separate populations and cannot be pooled with data from other ancillary equipment for analysis. Therefore, the data are most appropriately analyzed in tabular format. The data are presented in two types of formats. First, the data are presented by analyte and with its associated AL so that the result can be compared to each other and to the ALs. The second format is similar but shows the observed value expressed as a percent of the AL. The results are presented in pertinent subsections that follow. It is important to note that all constituents of concern were analyzed. However, only analytes that were detected are presented in the following subsections. Also, all analytical data were validated in accordance with technical procedures, and data validation flags were assigned based on laboratory performance in quality control analyses. Data flagged during validation may still be useful for making project decisions. When appropriate, discrepancies in the quality control analyses that were noted in the validation process are addressed in the following subsections. All reported results and the corresponding validation flags for the WM-181 vault sump are provided in Appendix C.

## 8.1 Metals Results in the WM-181 Vault Sump

Metals data were validated in accordance with technical procedures and data validation flags were assigned based on laboratory performance in quality control analyses (Portage Environmental, Inc. 2004d). Minor discrepancies were noted and data were flagged as estimated values; however, the impact to data usability should be minimal. Analytes that were reported in samples at concentrations similar to associated blanks were considered to be undetected and assigned “U” flags. All reported metals data and validation flags are shown in Appendix C.

The reported results for the metals data obtained from the vault sump are shown in Table 11 and Table 12 presents the data as a percentage of the AL. It can be seen from Table 12 that each of the metals are considerably less than the associated AL with mercury having the largest ratio of observed concentration to AL (40.13%). Therefore, it can be concluded that concentrations of all metals of concern do not exceed the associated ALs.

Table 11. Comparison of the reported metals data for the WM-181 vault sump to the corresponding ALs.

| Metal | CP10200601XM WM-181 SR-17 (μg/L) | Action Level (μg/L) | Action Level Exceeded? |
|---|---|---|---|
| Aluminum | 1.24E+03 | 3.1E+06 | No |
| Barium | 3.06E+01 | 8.3E+04 | No |
| Beryllium | 1.0E-01 | 5.3E+03 | No |
| Cadmium | 1.9E+00 | 6.1E+02 | No |
| Calcium | 6.43E+04 | NA[a] | NA[a] |
| Chromium | 1.01E+01 | 9.0E+02 | No |
| Cobalt | 1.4E+00 | 7.7E+05 | No |
| Copper | 9.4E+00 | 6.0E+05 | No |
| Iron | 6.78E+02 | 1.7E+06 | No |
| Lead | 1.54E+02 | 4.0E+03 | No |

Table 11. (continued).

| Metal | CP10200601XM WM-181 SR-17 (µg/L) | Action Level (µg/L) | Action Level Exceeded? |
|---|---|---|---|
| Magnesium | 3.44E+03 | NA[a] | NA[a] |
| Manganese | 3.72E+01 | 4.9E+05 | No |
| Mercury | 1.5E+00 | 1.6E+02 | No |
| Nickel | 5.07E+01 | 4.4E+05 | No |
| Potassium | 4.59E+03 | NA[a] | NA[a] |
| Sodium | 6.30E+03 | NA[a] | NA[a] |
| Zinc | 7.26E+01 | 1.7E+06 | No |

a. NA=Not applicable. An action level has not been established for this analyte.

Table 12. Comparison of the metals data obtained from the WM-181 vault sump expressed as a percentage of the corresponding ALs.

| Metal | CP10200601XM WM-181 SR-17 (µg/L) | Action Level (µg/L) | Observed Value/Action Level (%) |
|---|---|---|---|
| Aluminum | 1.24E+03 | 3.1E+06 | 0.040 |
| Barium | 3.06E+01 | 8.3E+04 | 0.037 |
| Beryllium | 1.0E-01 | 5.3E+03 | 0.0019 |
| Cadmium | 1.9E+00 | 6.1E+02 | 0.31 |
| Calcium | 6.43E+04 | NA | NA |
| Chromium | 1.01E+01 | 9.0E+02 | 1.1 |
| Cobalt | 1.4E+00 | 7.7E+05 | 0.00018 |
| Copper | 9.4E+00 | 6.0E+05 | 0.0016 |
| Iron | 6.78E+02 | 1.7E+06 | 0.040 |
| Lead | 1.54E+02 | 4.0E+03 | 3.9 |
| Magnesium | 3.44E+03 | NA | NA |
| Manganese | 3.72E+01 | 4.9E+05 | 0.0076 |
| Mercury | 1.5E+00 | 1.6E+02 | 0.94 |
| Nickel | 5.07E+01 | 4.4E+05 | 0.012 |
| Potassium | 4.59E+03 | NA | NA |
| Sodium | 6.30E+03 | NA | NA |
| Zinc | 7.26E+01 | 1.7E+06 | 0.0043 |

NA=Not applicable. An action level has not been established for this analyte.

## 8.2 Results for Anions in the WM-181 Vault Sump

Data usability was not negatively impacted by the discrepancies noted in the validation of the anions data (Portage Environmental, Inc. 2004e). Phosphate was reported in samples at concentrations that were indistinguishable from concentrations detected in associated laboratory blanks. Therefore, phosphate results are considered to be undetected and do not appear in Tables 13 and 14. All reported data and validation flags are shown in Appendix C. Table 13 presents the anion data generated from the vault sump and compares them to the corresponding AL. Table 14 shows the reported results as a percentage of the corresponding AL. Fluoride had the largest ratio of observed concentration to AL (0.021%). It can be seen from these data that the concentrations of anions in the vault sump are well below the ALs.

Table 13. Comparison of the anion data obtained from the WM-181 vault sump.

| Anion | CP10200601XM WM-181 SR-17 (mg/L) | Action Level (mg/L) | Action Level Exceeded? |
|---|---|---|---|
| Chloride | 2.94 | NA | NA |
| Fluoride | 0.16 | 770 | No |
| Nitrate | 209 | NA | NA |
| Sulfate | 20.5 | NA | NA |

NA=Not applicable. An action level has not been established for this analyte.

Table 14. Comparison of the anion data from the WM-181 vault sump expressed as a percentage of the AL.

| Anion | CP10200601XM WM-181 SR-17 (mg/L) | Action Level (mg/L) | Observed Value/Action Level (%) |
|---|---|---|---|
| Chloride | 2.94 | NA | NA |
| Fluoride | 0.16 | 770 | 0.021 |
| Nitrate | 209 | NA | NA |
| Sulfate | 20.5 | NA | NA |

NA=Not applicable. An action level has not been established for this analyte.

## 8.3 Results for Organics in the WM-181 Vault Sump

### 8.3.1 VOC Results

The volatile organic compound (VOC) data were validated in accordance with technical procedures and validation flags were assigned to reported results based on the laboratory performance on quality control analyses (Environmental Validation and Assessment Consultants, Inc. 2004a; Tetra Tech NUS, Inc. 2004). No issues that would negatively impact the data usability were identified. The reported results from all the VOC analyses and the corresponding validation flags are shown in Appendix C.

Tables 15 and 16 provide a comparison between the detected VOC results and the corresponding action limits. It can be seen from the data that each of the VOC observations are well below the ALs. The highest observed value, as expressed as a percentage of its AL, is 2-Butanone with a percent of 0.0199%. It can be concluded that the vault sump data have met closure standards with respect to VOCs.

Table 15. Comparison of the VOCs detected in the WM-181 vault sump rinsate to the corresponding ALs.

| Compound | CP10200601VG WM-181 SR-17 (µg/L) | Action Level (µg/L) | Action Level Exceeded? |
|---|---|---|---|
| 2-Butanone (MEK) | 31.9 | 160,000 | No |
| Acetone | 15.6 | 990,000 | No |
| Carbon disulfide | 43.4 | 990,000 | No |
| Cyclohexane | 1.1 | 7,500,000 | No |

Table 16. Reported VOC data from the WM-181 vault sump expressed as a percentage of the AL (i.e., observed value/AL).

| Compound | CP10200601VG WM-181 SR-17 (µg/L) | Action Level (µg/L) | Observed Value/Action Level (%) |
|---|---|---|---|
| 2-Butanone (MEK) | 31.9 | 160,000 | 0.0199 |
| Acetone | 15.6 | 990,000 | 0.00158 |
| Carbon disulfide | 43.4 | 990,000 | 0.00438 |
| Cyclohexane | 1.1 | 7,500,000 | 1.47E-05 |

### 8.3.2 SVOC and PCB Results

Data for semivolatile organic compound (SVOC) and polychlorinated biphenyl (PCB) analyses were also validated in accordance with technical procedures and validation flags were assigned based on the laboratory performance in the associated quality control analyses (Environmental Validation and Assessment Consultants, Inc. 2004b, 2004c). The compound isothiocyanatocyclohexane was reported as a tentatively identified compound (TIC), meaning that both the compound identification and quantification have much greater uncertainty. Compound identifications for TICs are based solely from a library search on the spectrum from a peak at any retention time, rather than from a known standard at a known retention time. Likewise, the concentration results for TICs are based on assumptions rather than an actual calibration; therefore, the reported quantities are estimates with a high degree of uncertainty. The compound is included for the sake of completeness in this DQA; however, it is considered to be highly suspect. No toxicity information is available for this compound. The reported result for Aroclor-1254 had greater than 25% difference in concentration between the two column methods. This means the result has higher uncertainty in the quantitated result. Based on the detection in this sample and a reported detection of Aroclor-1254 in one of the five samples collected from Tank WM-181 (ICP 2004a), an AL will be developed for this compound. The reported results from all the SVOC and PCB analyses and the corresponding validation flags are shown in Appendix C. The SVOC data for the detected compounds are presented in Tables 17 and 18. Phenol had the largest percentage (0.000058%) of the observed concentration of each SVOC and PCB relative to the AL. It can be safely concluded that the vault sump data have met closure criteria with respect to SVOCs.

Table 17. Comparison of the SVOC data obtained from the WM-181 vault sump with the specified ALs.

| Compound | CP10200601VG WM-181 SR-17 (µg/L) | Action Level (µg/L) | Action Level Exceeded? |
|---|---|---|---|
| 2-Nitrophenol | 1.1 | NA | NA[a] |
| Phenol | 1.4 | 2400000 | No |
| Tributyl phosphate | 1.4 | NA | NA |
| Aroclor-1254[b] | 1.2 | NA | NA |

a. NA=Not applicable. An action level for this analyte has not been established.
b. An action level for Aroclor-1254 is being developed.

Table 18. Reported SVOC data from the WM-181 vault sump expressed as a percentage of the AL (i.e., observed value/AL).

| Compound | CP10200601VG WM-181 SR-17 (µg/L) | Action Level (µg/L) | Observed Value/Action Level (%) |
|---|---|---|---|
| 2-Nitrophenol | 1.1 | NA | NA |
| Phenol | 1.4 | 2400000 | 5.8E-05 |
| Tributyl phosphate | 1.4 | NA | NA |
| Aroclor-1254 | 1.2 | NA | NA |

NA=Not applicable.

## 8.4 Results for pH in the WM-181 Vault Sump

The pH of the post-decontamination residuals collected from the WM-181 vault sump was also measured. The data for pH were validated according to technical procedures, and no issues with any applicable quality control criteria were identified (Portage Environmental, Inc. 2004e).

Table 19 shows the results reported for pH and the associated ALs. Laboratory results and associated validation flags for pH data presented in this DQA are listed in Appendix C. It can be seen from the results that pH values have not exceeded the ALs.

Table 19. Comparison of the pH data obtained from the WM-181 vault sump with the specified ALs.

| Analyte | CP10200601VG WM-181 SR-17 | Action Level | | Action Level Exceeded? |
|---|---|---|---|---|
| | | Lower | Upper | |
| pH | 7.0 | 2.0 | 12.5 | No |

## 8.5 Results for Radionuclides in the WM-181 Vault Sump

The data for radionuclide analyses were validated in accordance with technical procedures, and validation flags were assigned to sample results based on the established quality control criteria (Portage Environmental, Inc. 2004f, 2004g, 2004h, 2004i). The data are considered to be of high quality, and the data usability not significantly impacted by the assigned validation flags. Total strontium was determined as $^{90}$Sr. All isotopes of strontium other than $^{90}$Sr are short-lived and would not be present in the tank residuals. Therefore, total strontium and $^{90}$Sr are the same and used interchangeably throughout this document. The data for $^{99}$Tc were generated by inductively coupled plasma-mass spectrometry (ICP-MS). All reported results and the corresponding validation flags are shown in Appendix C. Results for the detected radionuclides are presented in Tables 20 and 21. For radionuclides, $^{129}$I had the largest percentage (0.249%) of the observed concentration relative to the corresponding inventory level. All detected radionuclides are reported at concentrations well below inventory levels.

Table 20. Comparison of the radionuclide data obtained from the WM-181 vault sump with the specified inventory levels.

| Radionuclide | CP10200601VG WM-181 SR-17 (pCi/L) | Inventory Level (pCi/L) | Inventory Level Exceeded? |
|---|---|---|---|
| $^{3}$H | 1.58E+03 | 1.61E+07 | No |
| $^{238}$Pu | 1.69E+03 | 5.70E+08 | No |
| $^{239/240}$Pu | 1.07E+03 | 7.05E+07 | No |
| $^{241}$Am | 7.13E+02 | 3.60E+07 | No |
| $^{237}$Np | 3.83E+01 | 3.43E+05 | No |
| $^{137}$Cs | 9.33E+05 | 1.15E+11 | No |
| $^{154}$Eu | 8.24E+01 | 1.83E+08 | No |
| $^{63}$Ni | 1.39E+02 | 8.70E+07 | No |
| $^{241}$Pu | 2.54E+02 | 4.24E+08 | No |
| $^{90}$Sr | 1.49E+06 | 8.15E+10 | No |
| $^{129}$I | 1.85E+02 | 7.44E+04 | No |
| $^{99}$Tc | 3.25E+01 | 2.99E+07 | No |

Table 21. Reported radionuclide data from the WM-181vault sump expressed as a percentage of the inventory level (i.e., observed value/inventory level).

| Radionuclide | CP10200601VG WM-181 SR-17 (pCi/L) | Inventory Level (pCi/L) | Observed Value/Inventory Level (%) |
|---|---|---|---|
| $^{3}H$ | 1.58E+03 | 1.61E+07 | 0.00981 |
| $^{238}Pu$ | 1.69E+03 | 5.70E+08 | 0.000296 |
| $^{239/240}Pu$ | 1.07E+03 | 7.05E+07 | 0.00152 |
| $^{241}Am$ | 7.13E+02 | 3.60E+07 | 0.00198 |
| $^{237}Np$ | 3.83E+01 | 3.43E+05 | 0.0112 |
| $^{137}Cs$ | 9.33E+05 | 1.15E+11 | 0.000811 |
| $^{154}Eu$ | 8.24E+01 | 1.83E+08 | 0.0000450 |
| $^{63}Ni$ | 1.39E+02 | 8.70E+07 | 0.000160 |
| $^{241}Pu$ | 2.54E+02 | 4.24E+08 | 0.0000599 |
| $^{90}Sr$ | 1.49E+06 | 8.15E+10 | 0.00183 |
| $^{129}I$ | 1.85E+02 | 7.44E+04 | 0.249 |
| $^{99}Tc$ | 3.25E+01 | 2.99E+07 | 0.000109 |

# 9. CONCLUSIONS

Rinsate samples were taken from the ancillary equipment associated with Tanks WM-103, WM-104, WM-105, WM-106, and WM-181 that were addressed in the HWMA/RCRA closure plan (DOE-ID 2004). Tanks WM-103, WM-104, WM-105, and WM-106 are not located in a concrete vault; therefore, ancillary equipment for Tanks WM-103, WM-104, WM-105, and WM-106 is limited to the cooling coils associated with these tanks. Tank WM-181 does not have cooling coils. Ancillary equipment for WM-181 is the vault sump.

Rinsate samples taken from the WM-103, WM-104, WM-105, and WM-106 cooling coils were analyzed for chromium, pH, and radionuclides of concern. None of the radionuclides of concern were detected in the final rinsate of the cooling coils. Levels of chromium and pH were well within the regulatory limits.

Data from the WM-181 vault sump could not be pooled with the cooling coil data for analysis. However, the data generated show that the WM-181 vault sump did not contain concentrations of constituents or radionuclides of concern that exceed the ALs.

None of the ancillary equipment associated with WM-103, WM-104, WM-105, WM-106, and WM-181 contained constituents of concern at concentrations that exceeded the action or inventory levels. Therefore, it can be concluded that closure standards have been met with regard to the ancillary equipment associated with these tank systems.

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# Appendix A

# Graphical Representation of Data from WM-103, WM-104, WM-105, and WM-106 Cooling Coils

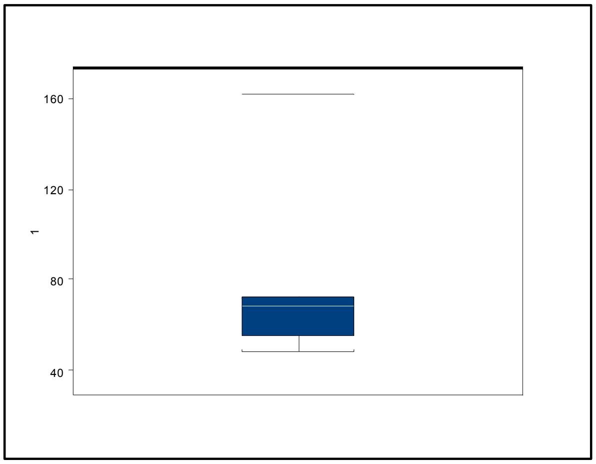


Figure A-1. Boxplot for chromium data.

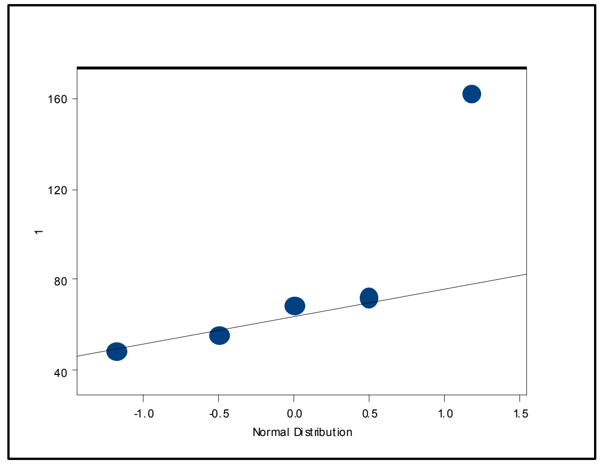


Figure A-2. Normal-quantile plot for chromium data.

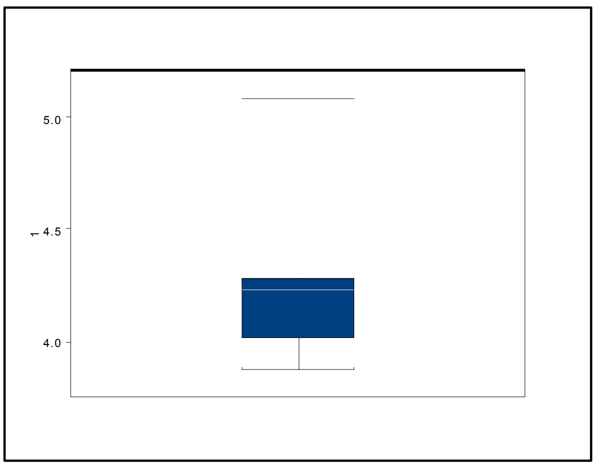


Figure A-3. Boxplot for chromium (ln[x] transformation) data.

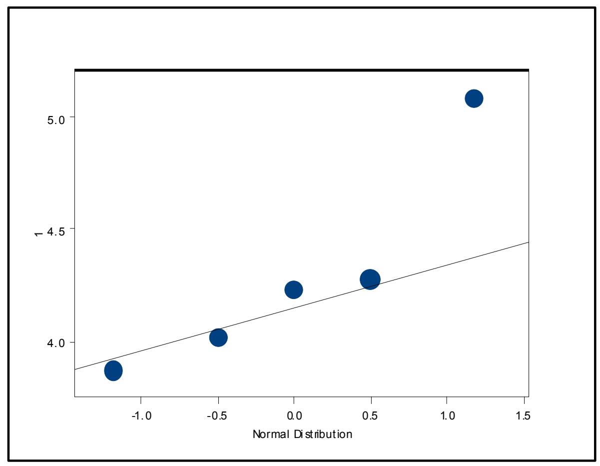


Figure A-4. Normal-quantile plot for chromium (ln[x] transformation) data.

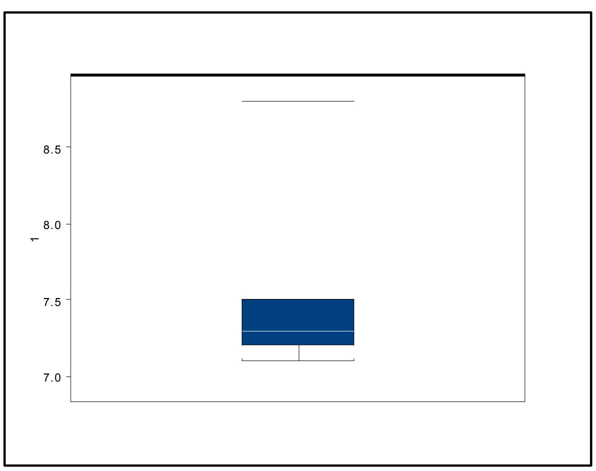


Figure A-5. Boxplot for pH data.

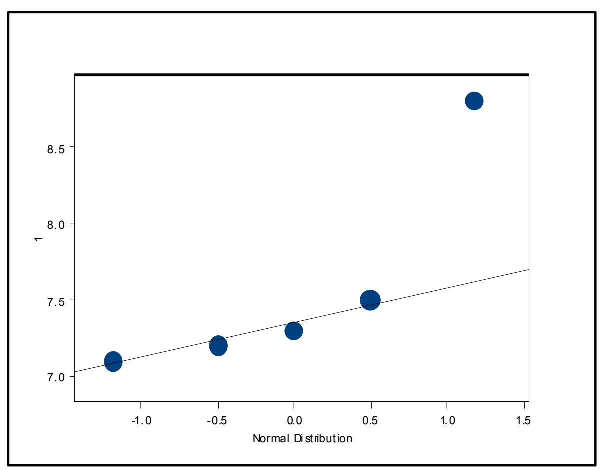


Figure A-6. Normal-quantile plot for pH data.

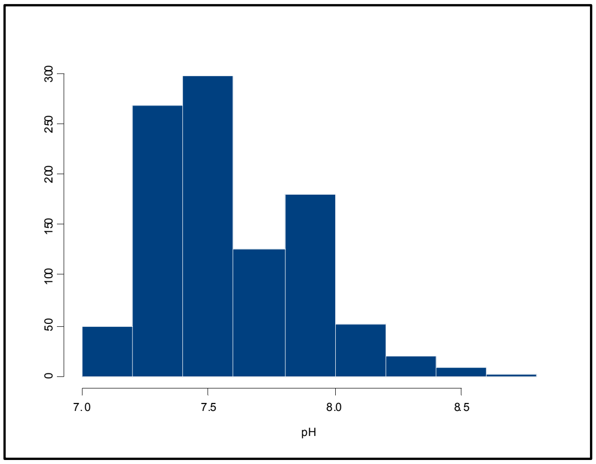


Figure A-7. Histogram of the sample mean distribution for pH estimated with bootstrapping.

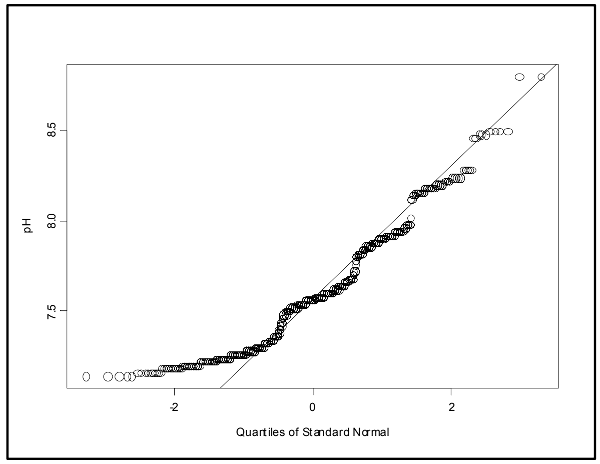


Figure A-8. Normal-quantile plot for the sample mean distribution for pH estimated with bootstrapping.

# Appendix B

# Reported Results for WM-103, WM-104, WM-105, and WM-106 Cooling Coils

Table B-1. Reported results for inorganic analyses for WM-103, WM-104, WM-105, and WM-106 cooling coils.

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag | Validator Flag |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10210101XM | 103/6 Coils WRA-10 | 4BJ83 | INORG | Total Metals | 7440-47-3 | Chromium | 1.62E+02 | µg/L | | |
| CP10210201XM | 103/6 Coils WRA-14 | 4BJ86 | INORG | Total Metals | 7440-47-3 | Chromium | 4.80E+01 | µg/L | | |
| CP10210301XM | 103/6 Coils WRA-17 | 4BJ89 | INORG | Total Metals | 7440-47-3 | Chromium | 7.21E+01 | µg/L | | |
| CP10210401XM | 103/6 Coils WRA-29 | 4BJ92 | INORG | Total Metals | 7440-47-3 | Chromium | 5.56E+01 | µg/L | | |
| CP10210501XM | 103/6 Coils WRA-34 | 4BJ95 | INORG | Total Metals | 7440-47-3 | Chromium | 6.87E+01 | µg/L | | |
| CP10210101PH | 103/6 Coils WRA-10 | 4BJ85 | INORG | Miscellaneous | pH | pH | 7.5 | N/A | | |
| CP10210201PH | 103/6 Coils WRA-14 | 4BJ88 | INORG | Miscellaneous | pH | pH | 7.1 | N/A | | |
| CP10210301PH | 103/6 Coils WRA-17 | 4BJ91 | INORG | Miscellaneous | pH | pH | 8.8 | N/A | | |
| CP10210401PH | 103/6 Coils WRA-29 | 4BJ94 | INORG | Miscellaneous | pH | pH | 7.3 | N/A | | |
| CP10210501PH | 103/6 Coils WRA-34 | 4BJ97 | INORG | Miscellaneous | pH | pH | 7.2 | N/A | | |

Table B-2. Reported results for radionuclide analyses for WM-103, WM-104, WM-105, and WM-106 cooling coils.

| Field Sample ID | Sampling Location | Lab Sample ID | Analysis Type | Analysis | Compound | Result | Units | Uncertainty | Validator Flag[a] | MDA[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{108m}$Ag | -1.81E+00 | pCi/L | 3.15E+00 | U | 5.55E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{108m}$Ag | 8.43E-01 | pCi/L | 2.10E+00 | U | 5.53E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{108m}$Ag | -1.86E-01 | pCi/L | 1.42E+00 | U | 5.67E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{108m}$Ag | 1.32E+00 | pCi/L | 2.64E+00 | U | 5.62E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{108m}$Ag | 3.34E+00 | pCi/L | 4.89E+00 | U | 5.96E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{110m}$Ag | 1.29E+00 | pCi/L | 3.21E+00 | U | 8.34E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{110m}$Ag | 1.71E+00 | pCi/L | 3.66E+00 | U | 8.30E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{110m}$Ag | 4.38E+00 | pCi/L | 6.62E+00 | U | 8.39E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{110m}$Ag | -3.67E-01 | pCi/L | 2.20E+00 | U | 8.39E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{110m}$Ag | -2.07E+00 | pCi/L | 3.88E+00 | U | 7.46E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{241}$Am | 5.74E+00 | pCi/L | 2.01E+01 | U | 6.35E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{241}$Am | -1.09E+01 | pCi/L | 2.54E+01 | U | 6.24E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{241}$Am | -1.62E+00 | pCi/L | 1.58E+01 | U | 6.38E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{241}$Am | 4.59E+00 | pCi/L | 1.86E+01 | U | 6.24E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{241}$Am | -4.66E-01 | pCi/L | 1.49E+01 | U | 6.55E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{144}$Ce | 2.22E+00 | pCi/L | 1.45E+01 | U | 5.29E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{144}$Ce | 1.23E+00 | pCi/L | 1.37E+01 | U | 5.41E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{144}$Ce | 1.17E+01 | pCi/L | 2.49E+01 | U | 5.25E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{144}$Ce | -1.13E+01 | pCi/L | 2.47E+01 | U | 5.40E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{144}$Ce | 9.44E+00 | pCi/L | 2.29E+01 | U | 5.48E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{58}$Co | 4.51E-02 | pCi/L | 1.34E+00 | U | 5.90E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{58}$Co | 3.04E+00 | pCi/L | 4.63E+00 | U | 5.96E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{58}$Co | 2.52E+00 | pCi/L | 4.05E+00 | U | 5.87E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{58}$Co | 1.23E+00 | pCi/L | 2.66E+00 | U | 5.98E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{58}$Co | 4.21E+00 | pCi/L | 6.03E+00 | U | 6.53E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{60}$Co | -1.47E+00 | pCi/L | 3.27E+00 | U | 1.00E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{60}$Co | 1.06E+00 | pCi/L | 1.52E+01 | U | 1.17E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{60}$Co | -2.35E+00 | pCi/L | 3.51E+00 | U | 8.59E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{60}$Co | 2.96E+00 | pCi/L | 4.27E+00 | U | 9.49E+00 |

Table B-2. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Analysis Type | Analysis | Compound | Result | Units | Uncertainty | Validator Flag[a] | MDA[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{60}$Co | -1.05E+01 | pCi/L | 1.27E+01 | U | 1.11E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{134}$Cs | 9.86E-03 | pCi/L | 1.40E+00 | U | 5.96E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{134}$Cs | -3.09E+00 | pCi/L | 4.55E+00 | U | 5.52E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{134}$Cs | 9.86E-03 | pCi/L | 1.40E+00 | U | 5.93E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{134}$Cs | 9.86E-03 | pCi/L | 1.36E+00 | U | 5.77E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{134}$Cs | 5.88E+00 | pCi/L | 7.76E+00 | U | 5.94E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{137}$Cs | -4.81E-01 | pCi/L | 7.98E+00 | U | 8.10E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{137}$Cs | -4.79E+00 | pCi/L | 8.01E+00 | U | 7.96E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{137}$Cs | -3.35E+00 | pCi/L | 8.08E+00 | U | 8.29E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{137}$Cs | -1.84E+00 | pCi/L | 8.01E+00 | U | 8.10E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{137}$Cs | 2.44E+00 | pCi/L | 1.32E+01 | U | 8.73E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{152}$Eu | -2.32E+00 | pCi/L | 6.68E+00 | U | 1.88E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{152}$Eu | 3.24E+00 | pCi/L | 7.81E+00 | U | 1.94E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{152}$Eu | 5.19E-02 | pCi/L | 4.72E+00 | U | 1.90E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{152}$Eu | -3.06E+00 | pCi/L | 7.41E+00 | U | 1.85E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{152}$Eu | 1.17E+01 | pCi/L | 1.72E+01 | U | 2.03E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{154}$Eu | -1.64E+00 | pCi/L | 5.43E+00 | U | 1.72E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{154}$Eu | 8.39E+00 | pCi/L | 1.33E+01 | U | 1.86E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{154}$Eu | 2.56E+00 | pCi/L | 6.23E+00 | U | 1.61E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{154}$Eu | 9.53E+00 | pCi/L | 1.44E+01 | U | 1.76E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{154}$Eu | 5.41E-01 | pCi/L | 3.97E+00 | U | 1.63E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{155}$Eu | 7.18E+00 | pCi/L | 1.49E+01 | U | 3.01E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{155}$Eu | -5.10E+00 | pCi/L | 1.25E+01 | U | 2.99E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{155}$Eu | -4.71E+00 | pCi/L | 1.21E+01 | U | 3.00E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{155}$Eu | 1.59E+01 | pCi/L | 2.45E+01 | U | 3.03E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{155}$Eu | -2.93E+00 | pCi/L | 1.03E+01 | U | 3.08E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{54}$Mn | 3.03E+00 | pCi/L | 4.75E+00 | U | 6.62E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{54}$Mn | 1.38E+00 | pCi/L | 2.87E+00 | U | 6.25E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{54}$Mn | 5.21E-01 | pCi/L | 1.89E+00 | U | 6.07E+00 |

Table B-2. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Analysis Type | Analysis | Compound | Result | Units | Uncertainty | Validator Flag[a] | MDA[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{54}$Mn | 2.33E+00 | pCi/L | 3.86E+00 | U | 6.05E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{54}$Mn | 4.27E+00 | pCi/L | 6.13E+00 | U | 6.73E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{94}$Nb | -3.09E+00 | pCi/L | 4.57E+00 | U | 5.50E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{94}$Nb | 1.59E+00 | pCi/L | 3.02E+00 | U | 5.92E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{94}$Nb | 2.16E+00 | pCi/L | 3.52E+00 | U | 5.37E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{94}$Nb | 1.25E+00 | pCi/L | 2.61E+00 | U | 5.78E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{94}$Nb | -7.14E-01 | pCi/L | 2.02E+00 | U | 5.72E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{95}$Nb | 1.71E+00 | pCi/L | 3.21E+00 | U | 6.00E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{95}$Nb | 6.40E-01 | pCi/L | 2.10E+00 | U | 6.31E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{95}$Nb | -6.19E-01 | pCi/L | 1.98E+00 | U | 5.87E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{95}$Nb | -1.12E-01 | pCi/L | 1.41E+00 | U | 5.81E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{95}$Nb | 2.74E+00 | pCi/L | 4.46E+00 | U | 6.61E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{103}$Ru | 1.33E+00 | pCi/L | 2.75E+00 | U | 6.06E+00 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{103}$Ru | -3.32E+00 | pCi/L | 4.87E+00 | U | 5.62E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{103}$Ru | 3.58E+00 | pCi/L | 5.37E+00 | U | 6.65E+00 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{103}$Ru | -2.66E+00 | pCi/L | 4.23E+00 | U | 6.05E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{103}$Ru | -1.14E+00 | pCi/L | 2.55E+00 | U | 6.10E+00 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{106}$Ru | -1.24E+01 | pCi/L | 2.52E+01 | U | 5.41E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{106}$Ru | -8.13E+00 | pCi/L | 2.06E+01 | U | 5.45E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{106}$Ru | -5.53E+00 | pCi/L | 1.81E+01 | U | 5.65E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{106}$Ru | 2.47E+01 | pCi/L | 3.93E+01 | U | 5.55E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{106}$Ru | 6.93E+00 | pCi/L | 1.95E+01 | U | 5.56E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{125}$Sb | -5.16E+00 | pCi/L | 9.16E+00 | U | 1.66E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{125}$Sb | -2.64E+00 | pCi/L | 6.34E+00 | U | 1.62E+01 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{125}$Sb | 5.57E+00 | pCi/L | 9.94E+00 | U | 1.82E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{125}$Sb | 5.27E+00 | pCi/L | 9.50E+00 | U | 1.76E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{125}$Sb | 4.43E+00 | pCi/L | 8.54E+00 | U | 1.74E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{65}$Zn | 3.90E+00 | pCi/L | 6.95E+00 | U | 1.26E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{65}$Zn | -2.69E+00 | pCi/L | 5.61E+00 | U | 1.26E+01 |

Table B-2. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Analysis Type | Analysis | Compound | Result | Units | Uncertainty | Validator Flag[a] | MDA[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{65}Zn$ | -4.16E+00 | pCi/L | 7.60E+00 | U | 1.43E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{65}Zn$ | -1.46E+00 | pCi/L | 4.31E+00 | U | 1.29E+01 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{65}Zn$ | -9.12E+00 | pCi/L | 1.26E+01 | U | 1.22E+01 |
| CP10210101R4 | 103/6 Coils WRA-10 | 4BJ84 | RADS | Gamma Spectroscopy | $^{95}Zr$ | 4.98E+00 | pCi/L | 7.74E+00 | U | 1.06E+01 |
| CP10210201R4 | 103/6 Coils WRA-14 | 4BJ87 | RADS | Gamma Spectroscopy | $^{95}Zr$ | 3.69E-01 | pCi/L | 2.43E+00 | U | 9.55E+00 |
| CP10210301R4 | 103/6 Coils WRA-17 | 4BJ90 | RADS | Gamma Spectroscopy | $^{95}Zr$ | 5.64E+00 | pCi/L | 8.43E+00 | U | 1.05E+01 |
| CP10210401R4 | 103/6 Coils WRA-29 | 4BJ93 | RADS | Gamma Spectroscopy | $^{95}Zr$ | -3.97E+00 | pCi/L | 6.33E+00 | U | 9.22E+00 |
| CP10210501R4 | 103/6 Coils WRA-34 | 4BJ96 | RADS | Gamma Spectroscopy | $^{95}Zr$ | 2.17E+00 | pCi/L | 4.85E+00 | U | 1.15E+01 |

a. Validator flags:

U=Analyte was analyzed for but was not detected.

b. MDA=Minimum detectable activity.

# Appendix C

# Reported Results for WM-181 Vault Sump

Table C-1. Reported results for metals analyses for WM-181 vault sump.

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7429-90-5 | Aluminum | 1.24E+03 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-36-0 | Antimony | 7.0E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-38-2 | Arsenic | 6.5E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-39-3 | Barium | 3.06E+01 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-41-7 | Beryllium | 1.0E-01 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-43-9 | Cadmium | 1.9E+00 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-70-2 | Calcium | 6.43E+04 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-47-3 | Chromium | 1.01E+01 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-48-4 | Cobalt | 1.4E+00 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-50-8 | Copper | 9.4E+00 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7439-89-6 | Iron | 6.78E+02 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7439-92-1 | Lead | 1.54E+02 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7439-95-4 | Magnesium | 3.44E+03 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7439-96-5 | Manganese | 3.72E+01 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7439-97-6 | Mercury | 1.5E+00 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7439-98-7 | Molybdenum | 4.0E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-02-0 | Nickel | 5.07E+01 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-09-7 | Potassium | 4.59E+03 | µg/L | B | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7782-49-2 | Selenium | 3.8E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-22-4 | Silver | 1.5E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-23-5 | Sodium | 6.30E+03 | µg/L | | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-28-0 | Thallium | 7.3E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-62-2 | Vanadium | 2.2E+00 | µg/L | U | |
| CP10200601XM | WM-181 SR-17 | 4BG34 | INORG | Total Metals | 7440-66-6 | Zinc | 7.26E+01 | µg/L | | |

a. Laboratory flags:

B=Analyte was below the required detection limit but greater than or equal to the instrument detection limit

U=Analyte was analyzed for but not detected.

Table C-2. Reported results for anions and pH analyses for WM-181 vault sump.

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601AN | WM-181 SR-17 | 4BG35 | INORG | Miscellaneous | 16887-00-6 | Chloride | 2.94 | mg/L | | |
| CP10200601AN | WM-181 SR-17 | 4BG35 | INORG | Miscellaneous | 16984-48-8 | Fluoride | 0.16 | mg/L | | |
| CP10200601AN | WM-181 SR-17 | 4BG35 | INORG | Miscellaneous | *NITRATE | Nitrate | 209 | mg/L | | |
| CP10200601AN | WM-181 SR-17 | 4BG35 | INORG | Miscellaneous | *PHOSPHATE | Phosphate | 0.29 | mg/L | U | |
| CP10200601AN | WM-181 SR-17 | 4BG35 | INORG | Miscellaneous | 14808-79-8 | Sulfate | 20.5 | mg/L | | |
| CP10200601PH | WM-181 SR-17 | 4BG36 | INORG | Miscellaneous | *PH | pH | 7.0 | N/A | | |

a. Laboratory flags:

U=Analyte was analyzed for but not detected.

Table C-3. Reported results for organic analyses for WM-181 vault sump.

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 12674-11-2 | Aroclor-1016 | 1.0 | µg/L | U | |
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 11104-28-2 | Aroclor-1221 | 1.0 | µg/L | U | |
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 11141-16-5 | Aroclor-1232 | 1.0 | µg/L | U | |
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 53469-21-9 | Aroclor-1242 | 1.0 | µg/L | U | |
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 12672-29-6 | Aroclor-1248 | 1.0 | µg/L | U | |
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 11097-69-1 | Aroclor-1254 | 1.2 | µg/L | P | |
| CP10200601PC | WM-181 SR-17 | 0405040-31A | ORG | PCB | 11096-82-5 | Aroclor-1260 | 1.0 | µg/L | U | UJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 92-52-4 | 1,1'-Biphenyl | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 108-60-1 | 2,2'-oxybis(1-Chloropropane) | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 95-95-4 | 2,4,5-Trichlorophenol | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 88-06-2 | 2,4,6-Trichlorophenol | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 120-83-2 | 2,4-Dichlorophenol | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 105-67-9 | 2,4-Dimethylphenol | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 51-28-5 | 2,4-Dinitrophenol | 10.5 | µg/L | U | UJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 121-14-2 | 2,4-Dinitrotoluene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 606-20-2 | 2,6-Dinitrotoluene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 91-58-7 | 2-Chloronaphthalene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 95-57-8 | 2-Chlorophenol | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 91-57-6 | 2-Methylnaphthalene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 95-48-7 | 2-Methylphenol (o-Cresol) | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 88-74-4 | 2-Nitroaniline | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 88-75-5 | 2-Nitrophenol | 1.1 | µg/L | J | J |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 91-94-1 | 3,3'-Dichlorobenzidine | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 99-09-2 | 3-Nitroaniline | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 534-52-1 | 4,6-Dinitro-2-methylphenol | 10.5 | µg/L | U | UJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 101-55-3 | 4-Bromophenyl phenyl ether | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 59-50-7 | 4-Chloro-3-methylphenol | 10.5 | µg/L | U | |

Table C-3. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 106-47-8 | 4-Chloroaniline | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 7005-72-3 | 4-Chlorophenyl phenyl ether | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 106-44-5 | 4-Methylphenol (p-Cresol) | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 100-01-6 | 4-Nitroaniline | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 100-02-7 | 4-Nitrophenol | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 83-32-9 | Acenaphthene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 208-96-8 | Acenaphthylene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 98-86-2 | Acetophenone | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 120-12-7 | Anthracene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 1912-24-9 | Atrazine | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 100-52-7 | Benzaldehyde | 10.5 | µg/L | U | UJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 56-55-3 | Benzo(a)anthracene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 50-32-8 | Benzo(a)pyrene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 205-99-2 | Benzo(b)fluoranthene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 191-24-2 | Benzo(g,h,i)perylene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 207-08-9 | Benzo(k)fluoranthene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 111-91-1 | bis-(2-chloroethoxy)methane | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 111-44-4 | bis-(2-Chloroethyl)ether | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 117-81-7 | bis-(2-ethylhexyl)phthalate | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 85-68-7 | Butyl benzyl phthalate | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 105-60-2 | Caprolactam | 10.5 | µg/L | U | UJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 86-74-8 | Carbazole | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 218-01-9 | Chrysene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 53-70-3 | Dibenzo(a,h)anthracene | 10.5 | µg/L | | U |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 132-64-9 | Dibenzofuran | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 84-66-2 | Diethyl Phthalate | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 131-11-3 | Dimethyl phthalate | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 84-74-2 | Di-n-butyl phthalate | 9.1[c] | µg/L | J | J |

Table C-3. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 117-84-0 | Di-n-octyl phthalate | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 206-44-0 | Fluoranthene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 86-73-7 | Fluorene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 118-74-1 | Hexachlorobenzene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 87-68-3 | Hexachlorobutadiene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 77-47-4 | Hexachlorocyclopentadiene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 67-72-1 | Hexachloroethane | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 193-39-5 | Indeno(1,2,3-cd)pyrene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 78-59-1 | Isophorone | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 1122-82-3 | Isothiocyanatocylohexane[d] | 186 | µg/L | NJ | NJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 91-20-3 | Naphthalene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 98-95-3 | Nitrobenzene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 62-75-9 | n-Nitrosodimethylamine | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 621-64-7 | n-Nitrosodi-n-propylamine | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 86-30-6 | n-Nitrosodiphenylamine | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 87-86-5 | Pentachlorophenol | 10.5 | µg/L | U | R[e] |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 85-01-8 | Phenanthrene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 108-95-2 | Phenol | 1.4 | µg/L | J | J |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 129-00-0 | Pyrene | 10.5 | µg/L | U | |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 110-86-1 | Pyridine | 10.5 | µg/L | U | UJ |
| CP10200601SV | WM-181 SR-17 | 0405040-30A | ORG | SVOC | 126-73-8 | Tributyl phosphate | 1.4 | µg/L | J | J |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 71-55-6 | 1,1,1-Trichloroethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 71-55-6 | 1,1,1-Trichloroethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 79-34-5 | 1,1,2,2-Tetrachloroethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 79-00-5 | 1,1,2-Trichloroethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 79-00-5 | 1,1,2-Trichloroethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-35-4 | 1,1-Dichloroethene | 10.0 | µg/L | U | |

Table C-3. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-35-4 | 1,1-Dichloroethene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 120-82-1 | 1,2,4-Trichlorobenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 120-82-1 | 1,2,4-Trichlorobenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 96-12-8 | 1,2-Dibromo-3-chloropropane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 96-12-8 | 1,2-Dibromo-3-chloropropane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 106-93-4 | 1,2-Dibromoethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 106-93-4 | 1,2-Dibromoethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 95-50-1 | 1,2-Dichlorobenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 95-50-1 | 1,2-Dichlorobenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 78-87-5 | 1,2-Dichloropropane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 78-87-5 | 1,2-Dichloropropane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 541-73-1 | 1,3-Dichlorobenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 541-73-1 | 1,3-Dichlorobenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 106-46-7 | 1,4-Dichlorobenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 106-46-7 | 1,4-Dichlorobenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 78-93-3 | 2-Butanone | 31.9 | µg/L | | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 78-93-3 | 2-Butanone | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 591-78-6 | 2-Hexanone | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 591-78-6 | 2-Hexanone | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 108-10-1 | 4-Methyl-2-pentanone | 10.0 | µg/L | U | UJ |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 108-10-1 | 4-Methyl-2-pentanone | 10.0 | µg/L | U | UJ |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 67-64-1 | Acetone | 15.6 | µg/L | | J |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 67-64-1 | Acetone | 23.0 | µg/L | | U |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 71-43-2 | Benzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 71-43-2 | Benzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-27-4 | Bromodichloromethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-27-4 | Bromodichloromethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-25-2 | Bromoform | 10.0 | µg/L | U | |

Table C-3. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-25-2 | Bromoform | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 74-83-9 | Bromomethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 74-83-9 | Bromomethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-15-0 | Carbon disulfide | 43.4 | µg/L | | J |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-15-0 | Carbon disulfide | 10.0 | µg/L | U | UJ |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 56-23-5 | Carbon tetrachloride | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 56-23-5 | Carbon tetrachloride | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 108-90-7 | Chlorobenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 108-90-7 | Chlorobenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-00-3 | Chloroethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-00-3 | Chloroethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 67-66-3 | Chloroform | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 67-66-3 | Chloroform | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 74-87-3 | Chloromethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 74-87-3 | Chloromethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 156-59-2 | cis-1,2-Dichloroethene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 156-59-2 | cis-1,2-Dichloroethene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 10061-01-5 | cis-1,3-Dichloropropene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 10061-01-5 | cis-1,3-Dichloropropene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 110-82-7 | Cyclohexane | 1.1 | µg/L | J | J |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 110-82-7 | Cyclohexane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 108-94-1 | Cyclohexanone | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 108-94-1 | Cyclohexanone | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 124-48-1 | Dibromochloromethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 124-48-1 | Dibromochloromethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-71-8 | Dichlorodifluoromethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-71-8 | Dichlorodifluoromethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 141-78-6 | Ethyl acetate | 10.0 | µg/L | U | |

Table C-3. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 141-78-6 | Ethyl acetate | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 100-41-4 | Ethylbenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 100-41-4 | Ethylbenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 76-13-1 | Freon 113 | 10.0 | µg/L | U | UJ |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 76-13-1 | Freon 113 | 10.0 | µg/L | U | UJ |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 98-82-8 | Isopropylbenzene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 98-82-8 | Isopropylbenzene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 13-302-07 | m,p-Xylenes | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 13-302-07 | m,p-Xylenes | 10.0 | µg/L | U | |
| CP10200601VA | WM-181 SR-17 | 0405040-29A | ORG | VOC | 67-56-1 | Methanol | 20.0 | MG/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 79-20-9 | Methyl acetate | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 79-20-9 | Methyl acetate | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 108-87-2 | Methyl cyclohexane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 108-87-2 | Methyl cyclohexane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-09-2 | Methylene Chloride | 92.4 | µg/L | | U |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-09-2 | Methylene Chloride | 60.1 | µg/L | | U |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 95-47-6 | o-Xylene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 95-47-6 | o-Xylene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 100-42-5 | Styrene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 100-42-5 | Styrene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 127-18-4 | Tetrachloroethene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 127-18-4 | Tetrachloroethene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 108-88-3 | Toluene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 108-88-3 | Toluene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 156-60-5 | trans-1,2-Dichloroethene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 156-60-5 | trans-1,2-Dichloroethene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 10061-02-6 | trans-1,3-Dichloropropene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 10061-02-6 | trans-1,3-Dichloropropene | 10.0 | µg/L | U | |

Table C-3. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Type | Analysis | CAS-Number | Compound | Result | Units | Lab Flag[a] | Validator Flag[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 79-01-6 | Trichloroethene | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 79-01-6 | Trichloroethene | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-69-4 | Trichlorofluoromethane | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-69-4 | Trichlorofluoromethane | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 75-01-4 | Vinyl Chloride | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 75-01-4 | Vinyl Chloride | 10.0 | µg/L | U | |
| CP10200601VG | WM-181 SR-17 | 0405040-28A | ORG | VOC | 1330-20-7 | Xylene (Total) | 10.0 | µg/L | U | |
| CP10200801VG | Trip Blank | 0405040-32A | ORG | VOC | 1330-20-7 | Xylene (Total) | 10.0 | µg/L | U | |

a. Laboratory flags:

J=Analyte was detected but was less than the quantitation limit.

N=Identification based on presumptive evidence.

P=Greater than 25% difference for the detected concentration in the 2nd column method.

U=Analyte was not detected. Quantitation limit is reported.

b. Validator flags:

J=Estimated

N=Identification based on presumptive evidence

R=Rejected

U=Undetected.

c. Reported results for this compound were deemed highly suspect and not used in this DQA. Phthalates are ubiquitous in nature and low levels are commonly assumed to be associated with laboratory contamination.

d. This compound was reported as a TIC and is considered to be highly suspect.

e. The validation flag "R" (rejected) was assigned based on low recovery in the laboratory control sample analysis. All other QC results associated with this compound were acceptable.

Table C-4. Reported results for radionuclide analyses for WM-181 vault sump.

| Field Sample ID | Sampling Location | Lab Sample ID | Analysis Type | Analysis | Compound | Result | Units | Uncertainty | Validator Flag[a] | MDA[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601R8 | WM-181 SR-17 | 4BG38 | RADS | Specific Analysis | $^{3}$H | 1.58E+03 | pCi/L | 8.30E+01 | J | 7.38E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{238}$Pu | 1.69E+03 | pCi/L | 2.05E+02 | | 2.20E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{239/240}$Pu | 1.07E+03 | pCi/L | 1.38E+02 | | 2.23E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{241}$Am | 7.13E+02 | pCi/L | 1.35E+02 | | 2.21E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{242}$Cm | 0.00E+00 | pCi/L | 0.00E+00 | U | 3.43E+00 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{244}$Cm | -2.71E-01 | pCi/L | 4.49E-01 | U | 6.16E+00 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{237}$Np | 3.83E+01 | pCi/L | 1.06E+01 | | 1.94E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{234}$U | 3.09E+00 | pCi/L | 4.97E+00 | U | 1.36E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{235}$U | -4.32E-01 | pCi/L | 7.25E-01 | U | 1.21E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Alpha Emitters | $^{238}$U | 8.58E-01 | pCi/L | 1.42E+00 | U | 9.59E+00 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{108m}$Ag | -1.65E+01 | pCi/L | 1.50E+02 | U | 5.93E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{110m}$Ag | 3.95E+01 | pCi/L | 6.50E+01 | U | 1.03E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{241}$Am | -4.03E+00 | pCi/L | 1.45E+03 | U | 6.33E+03 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{144}$Ce | 2.95E+02 | pCi/L | 1.05E+03 | U | 3.29E+03 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{58}$Co | 2.04E+00 | pCi/L | 1.99E+01 | U | 8.05E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{60}$Co | 7.91E+01 | pCi/L | 1.03E+02 | U | 7.99E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{134}$Cs | -4.82E+01 | pCi/L | 1.25E+02 | U | 3.35E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{137}$Cs | 9.33E+05 | pCi/L | 7.16E+04 | | 2.92E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{152}$Eu | -4.00E+02 | pCi/L | 7.82E+02 | U | 1.57E+03 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{154}$Eu | 8.24E+01 | pCi/L | 1.47E+01 | | 1.25E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{155}$Eu | -9.18E+01 | pCi/L | 5.69E+02 | U | 1.98E+03 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{54}$Mn | -2.02E+01 | pCi/L | 3.84E+01 | U | 7.62E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{94}$Nb | 8.72E-02 | pCi/L | 2.18E+01 | U | 8.92E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{95}$Nb | -1.72E+00 | pCi/L | 2.04E+01 | U | 8.31E+01 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{103}$Ru | 2.26E+02 | pCi/L | 3.63E+02 | U | 5.24E+02 |

Table C-4. (continued).

| Field Sample ID | Sampling Location | Lab Sample ID | Analysis Type | Analysis | Compound | Result | Units | Uncertainty | Validator Flag[a] | MDA[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{106}Ru$ | -1.13E+03 | pCi/L | 1.94E+03 | U | 3.28E+03 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{125}Sb$ | 8.77E+01 | pCi/L | 4.90E+02 | U | 1.78E+03 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{65}Zn$ | 4.83E+01 | pCi/L | 8.34E+01 | U | 1.46E+02 |
| CP10200601X3 | WM-181 SR-17 | 4BG37 | RADS | Gamma Emitters | $^{95}Zr$ | 4.46E+01 | pCi/L | 8.12E+01 | U | 1.54E+02 |
| CP10200601X4 | WM-181 SR-17 | 0405040-27 | RADS | Specific Analysis | $^{63}Ni$ | 1.39E+02 | pCi/L | 2.06E+01 | | 4.90E+01 |
| CP10200601X4 | WM-181 SR-17 | 0405040-27 | RADS | Specific Analysis | $^{241}Pu$ | 2.54E+02 | pCi/L | 6.38E+00 | J | 1.26E+02 |
| CP10200601X4 | WM-181 SR-17 | 0405040-27 | RADS | Specific Analysis | $^{90}Sr$ | 1.49E+06 | pCi/L | 1.12E+04 | | 2.03E+03 |
| CP10200601X5 | WM-181 SR-17 | 022S-06-A | RADS | Specific Analysis | $^{14}C$ | 3.74E+00 | pCi/L | 4.60E+00 | UJ | 1.52E+01 |
| CP10200601X5 | WM-181 SR-17 | 022S-06-A | RADS | Specific Analysis | $^{129}I$ | 1.85E+02 | pCi/L | 1.31E+01 | | 1.55E+01 |
| CP10200601EA | WM-181 SR-17 | 4BG39 | RADS | ICP-MS | $^{99}Tc$ | 3.25E+01 | pCi/L | | | |

a. Validator flags:

J=Estimated value

U=Analyte was analyzed for but was not detected.

b. MDA=Minimum detectable activity.